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Security Based Domotics

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Abstract

This paper provides a design and implementation of an automated control system of household appliances. Routine functions can be conveniently performed thereby saving time, energy and effort viz. switching of appliances. The proposed system can be divided into three modules- sensing, decision making, and implementation. The sensing system provides the microcontroller with data regarding external environment. The second module takes its decision based on this data. The final module implements this decision through a relay. The logic was implemented in Atmel ATmega 8 to achieve proposed aim. Installed sensors were found to be quite efficient in an ordinary small scale system. Modifications can be made to increase effectiveness by using PIR or Ultrasonic Sensors. Simple circuitry with cheap components used makes it a feasible option in home based automation.

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Keywords-component; Automation, Atmega8 Microcontroller, Sensor, Energy Saving System, ADC;

1. Introduction

With advancement of technology things are becoming simpler and easier for us. Home automation is a feasible option and one step ahead in this modern technological hierarchy. Household automation is receiving huge commercial acceptance, ABI Research estimates that 204,000 home automation systems were shipped globally in 2009 [14]. It is the control of any or all electrical appliances in our home, whether we are there or away. A remote household appliance control has been described in [1]-[4] using internet. Home automation is also achieved by use of Bluetooth as described in [5]. In [6] a GSM based system for home automation is described which uses voice commands for control. In [7] voice commands for home automation are being described. Bell G. et al. gives a

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futuristic vision of household automation in [8]. In this paper we describe an automatic household appliance control system which can control various household appliances considering the environmental conditions. This system would be able to sense the presence of any person and would switch ON OFF appliances taking into account the various sensor data. The block diagram of the overall system is given in figure 1. The proposed solution will be easy, robust, cost effective solution to home based automation system. This system can be used to effectively control any appliances at any environment with a little modification in the sensors and the embedded coding.

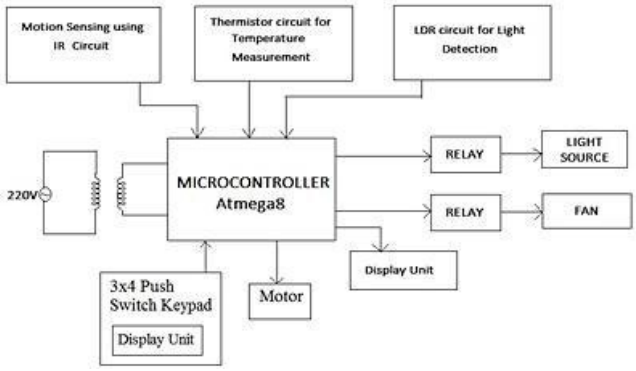

Fig.1. Block diagram of the system.

2. System Component Description

The hardware architecture consist of a stand-alone embedded system that is based on 8-bit microcontroller(Atmel ATmega 8),one medium sized LDR sensor, two strips of IR obstacle detection sensor, a thermistor and a relay.

The IR sensors (Ultra-sonic can also be used) are used to keep record of any person entering or leaving the room. The LDR sensors provide the microcontroller with the light intensity details of the room. The thermistor communicates the temperature to the microcontroller. The microcontroller takes the decision based on these sensor data and the previously designated threshold value of each. The detail description of individual module of the system is as follows.

2.1. Sensors

The system makes use of three types of sensors to sense the environmental condition of the room. These are described in the following lines.

2.1.1 IR Sensors (Ultra-Sonic can also be used)

Infrared Sensors are the most commercially used obstacle detection sensors. This sensor has two parts, one infrared transmitter and an infrared detector. The infrared transmitter emits light in infrared band. This light is reflected on the obstacle and then sensed by the detector. This sensor is connected to the ADC port of the micro controller, thus enabling it to have digital value if any object is present or not.

2.1.2 LDR sensors

Light Dependent Resistor is a resistor which exhibits photoconductivity i.e its resistance decreases with increasing light intensity. The LDR is connected to the ADC pins of the microcontroller. This resistance change is converted into a digital voltage level by means of ADC. This enables the microcontroller to have digital realisation of the light intensity present in the room.

2.1.3 Thermistor

Thermistor is a type of resistor whose resistance varies significantly with temperature, more so than in standard resistor. It generally has a negative temperature coefficient (NTC) and are widely used in inrush current limiter. Here the responsive resistance change due to temperature is converted to digital value by the ADC of the microcontroller.

2.2. Microcontroller and display unit

The Atmel AVR ATmega8 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs approaching 1MIPS per MHz, allowing the system designer to optimize power consumption versus processing speed [13]. ATmega 8 was chosen due to its wide versatility and availability of inbuilt ADC.

Liquid crystal displays (LCD) is an alphanumeric display and widely used in recent years as compared to LEDs. We interfaced a 16x2 LCD display. This display was used to communicate the present working status of the system to the user. It shows how many persons are inside the room and the condition of the appliances.

2.3 Relay switching

A relay is an electrically operated switch which uses an electromagnet to operate upon a switching mechanism. It helps interfacing the home appliances which work on 220 volts AC supply with any digital logic circuit working on a supply of 3-18 volts DC.

2.4 Security system

The microcontroller based security system is basically an access control system that allows only authorized personnel to access a restricted area. A keypad with 4x3 push switch is used which is simply a manual control device which completes the connection across two contacts. It actuates a signal across itself whenever it is pushed and then disconnects all kinds of contacts when released.

2.5 Motor

Thus the proposed system can automatically close doors if it is kept open by the use of a motor. In this model we used stepper motor so as to control the angle.

3. Design and Implementation

The implementation of the system is divided into three following parts so as to individually demonstrate them.

3.1 Sensor positioning

3.1.1 IR sensors

The two IR Sensors are positioned near the door as shown in Figure 2 (a). They are placed outside the arc of the door. So that it cannot be considered as an obstacle. The sensor placement is such that person entering or exiting the door comes in the range of the IR sensors. It detects the person as an obstacle and the sequence of detection determines if he is entering or exiting. IR set 1 and set 2 are interfaced at ADC2 PORT 25 and ADC3 PORT 26 respectively. The interfacing is done through LM 324 comparator to get only HIGH and LOW as output.

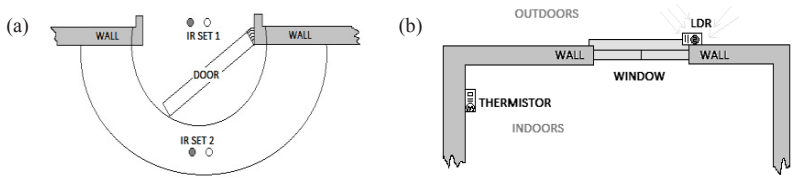

Fig. 2. (a) positioning of the IR sensors; (b) positioning of the LDR and thermistor.

3.1.2 LDR and thermistor

The LDR is connected outside the window so as to determine the light intensity as shown in Fig 2(b). The measured light intensity of exterior environment is measured so as to decide if it is day or night. It is interfaced at ADC0 PORT 23.

Similarly the thermistor is installed inside the room so as to determine the present room temperature. It is interfaced at ADC5 PORT 28

3.1.3 Circuit design

The intricate circuitry is a conglomerate of four sensor circuit, a LCD display unit and two appliances interfaced through a relay. The development board receives power from a DC 5 Volt adapter. The entire circuit diagram is shown below in fig 3.

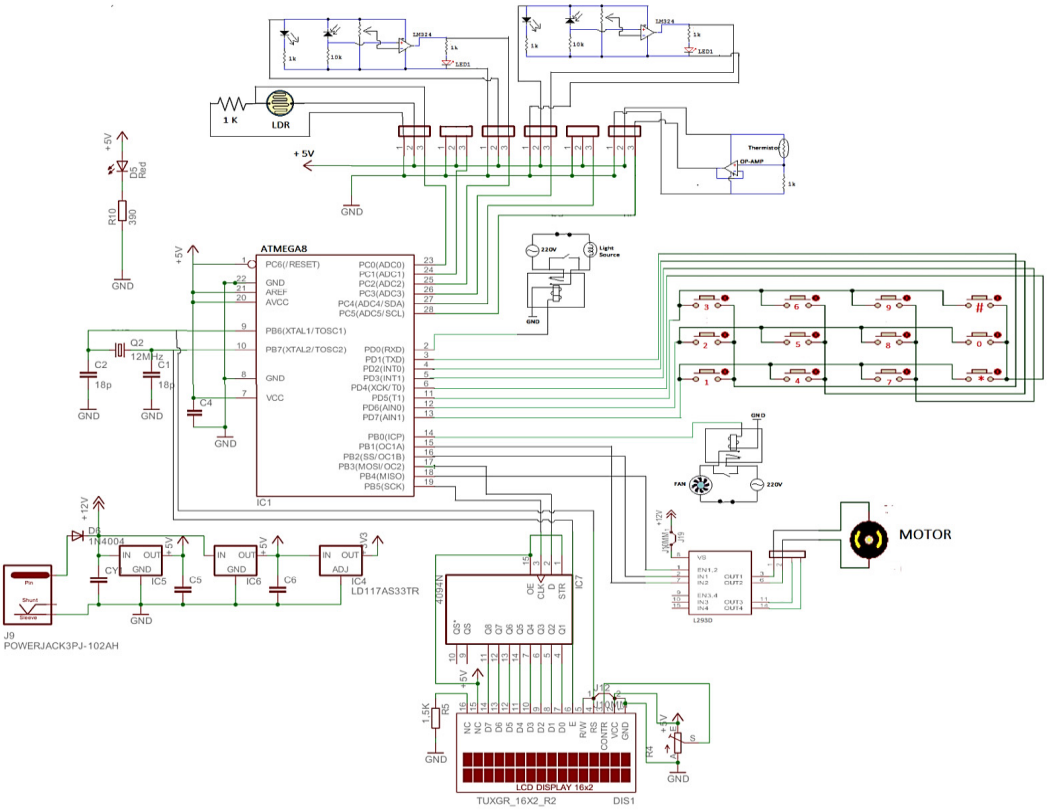

Fig. 3. The circuit diagram of the system.

4. Algorithm

STEP 1: An IR is set outside the room, if it does not detect then go to step15 and if it does then proceed.
STEP 2: If button '#' is pressed then go to the reset module and if no then go to step4.
STEP 3: In reset module, go to step4 and enter the password to be set. Store the password.
STEP 4: Check the password, word by word sequentially in the checking module.
STEP 5: In checking module compare the entered password sequentially with the corresponding bit in the present password.
STEP 6: If the password does not match, then door remains closed otherwise the door opens.
STEP 7: Set a delay of 2 minutes, so that microprocessor waits for inside IR to detect.
STEP 8: An IR is set inside the room, if it does not detect then go to step15 and if it does then proceed.
STEP 9: Set the counter and increment it.
STEP 10: Now simultaneously check both the temperature (thermistor) and light (L.D.R) detector.
STEP 11: If temperature is greater than 22^0c then switch on the fan otherwise switch it off.
STEP 12: If the outside L.D.R value is greater than the threshold value then switch on the light otherwise made it off.
STEP 13: An IR is set inside the room, if it does not detect then go to step 10 and if it does then proceed.
STEP 14: Set a delay of 10 seconds, so that microprocessor waits for outside IR to detect.
STEP 15: An IR is set outside the room, if it does not detect then go to step 10 and if it does then proceed.
STEP 16: Decrement the counter set in step 9.
STEP 17: Check whether it is greater than equal to 0.
STEP 18: If yes, then go to step 1.
STEP 19: If No, then switch off both light and fan. Door is locked.

5. Result

It successfully achieved its aim of automating the appliances. The system was quite responsive in normal situation. The IR sensor showed degraded performance in presence of sunlight although night performance was satisfactory. The Thermistor was effective from 10ºC to 25ºC although the response was slow.LDR placed in shaded region to avoid direct sunlight was apt for the purpose. A graph demonstrating the voltage response of the LDR to light intensity is drawn in fig 4(a).

The threshold value for which the microcontroller triggers the switching action is represented by thick line in the graph. The ADC reading of the thermistor was calibrated against a standard temperature scale in degree Celsius. Hence a graph demonstrating the temperature variation throughout a day is plotted in fig 4(b).

The project implementation of the thermistor is shown in fig 5(a). The main circuit board is connected close to the main switch board. The real time imaging of the LDR circuit is shown in Fig 5(b).

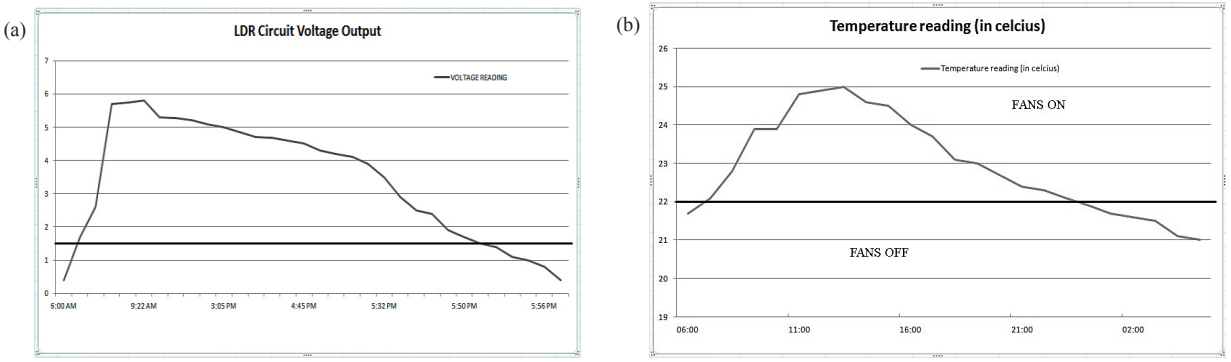

Fig. 4. (a)Graph of LDR reading vs time ; (b) Graph of thermistor reading vs time.

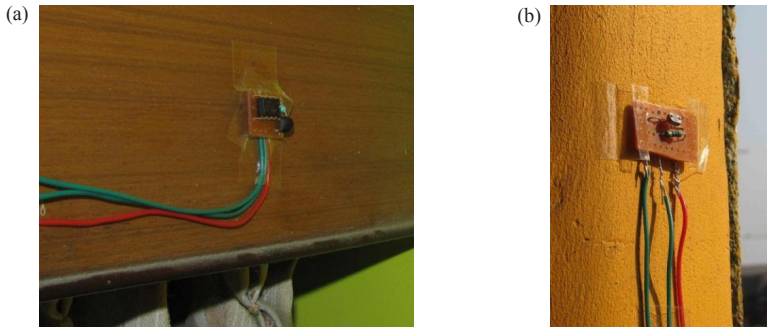

Fig 5. (a) The thermistor circuit; (b) The LDR circuit.

The test circuits for all the sensors was put together to obtain the results as shown in fig 6. The figure shows the main microcontroller unit with the sensors interfaced to it. This circuit is again connected to the LIGHTS and FAN through relay.

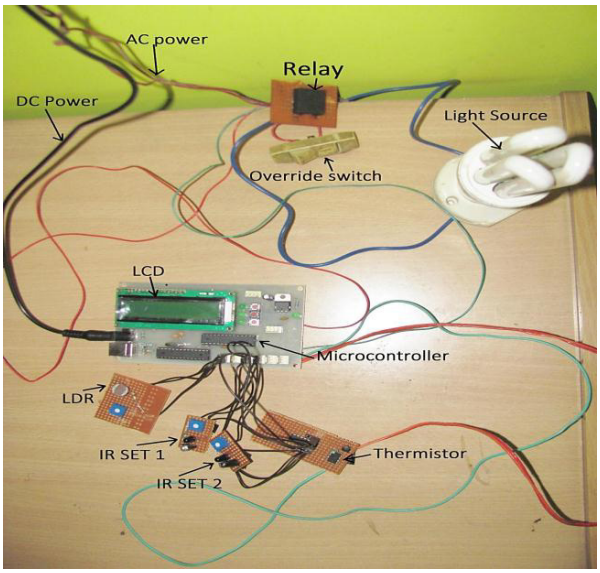

Fig. 6. The real time view of the complete circuit.

6. Conclusion

Related research has outlined the principles of intelligent home control [9], pointed out the possible challenges [10-11] and recommended the approaches to control devices [12]. In this paper low cost, ubiquitously accessible, auto-configurable, energy saving automation of homes has been introduced. The approach discussed in the paper has achieved the target to autonomously control the household appliances taking into consideration various sensor data. It is not limited for any particular application, it can be used anywhere in a process industries with little modifications in embedded coding according to the requirements. This concept not only ensures that our work will be usable in the future but also provides the flexibility to adapt and extend, as needs change.

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